# Clean Air Status and Trends Network
# Quality Assurance Report

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| **EPA Contract No.:** | **68-D-03-052 (Base Program)** |
| **MACTEC Project No.:** | **6064057000** |
| **Reporting Period:** | **Second Quarter 2006 (April - June)** |

## Summary of Quarterly Operations

### Introduction

This quarterly report summarizes results from the Clean Air Status and Trends Network (CASTNET) quality assurance/quality control (QA/QC) program for data collected during second quarter 2006. The results presented for filter pack data collection and field calibrations are generated from data extracted from the CASTNET Data Management Center (DMC) database using the CASTNET Data Management System Application (CDMSA). The various QA/QC criteria and policies are documented in the CASTNET Quality Assurance Project Plan (QAPP). The QAPP is comprehensive and includes standards and policies for all components of project operation from site selection through final data reporting. It is updated annually. The CASTNET QAPP, Revision 3.0 was approved by EPA during first quarter 2006.

Collocated filter pack precision data and completeness data for meteorological measurements are presented for data validated to Level 3 during the quarter. Table 1 lists the quarters of data that were validated to Level 3 during the quarter by site calibration group. Table 2 lists the sites in each calibration group along with the calibration schedule.

Table 3 presents the measurement criteria for continuous field measurements. These criteria apply to the instrument challenges performed during site calibrations. Table 4 presents the measurement criteria for laboratory filter pack measurements. These criteria apply to the QC samples listed in the following section of this report.

### Quality Control Analysis Count

The QC sample statistics presented in this report are for reference standards (RF) and continuing calibration verification spikes (CCV) used to assess accuracy and for replicate sample analyses (RP) used to assess "in-run" precision. In addition, laboratory method blanks (MB) containing reagents without a filter; laboratory blanks (LB) containing reagents and a new, unexposed filter; and field blanks (FB) containing reagents and an unexposed filter that was loaded into a filter pack assembly and shipped to and from the monitoring site while remaining in sealed packaging are also included. Table 5 presents the number of analyses in each category that were performed during this quarter.

### Sample Receipt Statistics

For the current CASTNET project, which began on July 30, 2003, the Environmental Protection Agency (EPA) requires that 95 percent of field samples from EPA-sponsored sites must be received by the CASTNET laboratory in Gainesville, FL no later than 14 days after removal from the sampling tower. Table 6 presents the relevant sample receipt statistics for second quarter 2006.

### Data Quality Indicator (DQI) Results

Figures 1 through 3 present the results of RF, CCV, and RP QC sample analyses for second quarter 2006. All results were within the criteria listed in Table 4 with the exception of several individual RP results. However, these are considered reasonable since higher relative percent differences generally correlate with lower sample concentrations. Quarterly averages are all within criteria except for the cellulose filter replicate average. The quarterly average replicate percent difference (RPD) for cellulose filter sulfur dioxide results is slightly above the 5 percent criterion at 5.74 percent. The average was skewed by a few high RPD results from sample values less than two times the reporting limit.

Figure 4 presents completeness statistics for continuous measurements validated to Level 3 during the quarter. All parameters met the 90 percent criterion except for wind direction parameters, which ranged from 88 to 89 percent. The lower recoveries for wind direction parameters were largely due to equipment problems.

### Blank Results

Figures 5 through 7 present the results of MB, LB, and FB QC sample analyses for second quarter 2006. All results were within criteria (two times the detection limit) listed in Table 4 with the exception of a few Teflon® filter FB and LB results. One calcium and one sodium result each were large enough to indicate a potential isolated contamination. No systemic problems were indicated upon closer review.

### Suspect/Invalid Filter Pack Samples

Eight filter pack samples were invalidated due to insufficient flow volume. Of those, six occurred due to site communication problems. Data for those six samples may be recovered during Level 3 validation. The samples and associated site identification are presented in Table 7.

### Field Problem Count

Table 8 presents counts of field problems affecting continuous data collection. The problem counts are sorted by a 30, 60, or 90 day time period to resolution. A category for unresolved problems is also included. Time to resolution indicates the period taken to implement corrective action. The time period does not correlate with the quantity of data affected. For example, if a

5-hour block of missing data takes 60 days to replace, it will show up in the 60 day category. By the same token, a site missing 200 hours of data due to the damage caused by a lightning strike will show up in the 30 day category if the site is repaired within 30 days, even though the data cannot be replaced.

## Field Calibration Results

Calibrations were performed at 27 sites during second quarter 2006. All sites and parameters were within the criteria listed in Table 3 with the exception of those listed in Table 9.

# Tables and Figures

**Table 1.** Data Validated to Level 3 during Second Quarter 2006

| Calibration Group* | Months Available | Number of Months | Complete Quarters | Number of Quarters |
|---|---|---|---|---|
| 2 | August 2005 – January 2006 | 6 | Quarter 4, 2005 | 1 |
| 3† | September 2005 – February 2006 | 6 | Quarter 4, 2005 | 1 |
| 4 | October 2005 – March 2006 | 6 | Quarter 4, 2005 – Quarter 1, 2006 | 2 |

**Note:** * The sites contained in each calibration group are listed in Table 2.
† Contains MCK131/231, KY collocated pair

**Table 2.** Field Calibration Schedule

| Calibration Group Number | Months Calibrated | Sites Calibrated | | | |
|---|---|---|---|---|---|
| 1 | January/July | SND152, AL | BFT142, NC | PNF126, NC | PED108, VA |
| | | GAS153, GA | CND125, NC | ESP127, TN | VPI120, VA |
| | | CDZ171, KY | COW137, NC | SPD111, TN | |
| 2 | February/August | CAD150, AR | BEL116, MD | WSP144, NJ | ARE128, PA |
| | | IRL141, FL | BWR139, MD | CTH110, NY | PSU106, PA |
| | | SUM156, FL | CVL151, MS | CHE185, OK | ALC188, TX |
| 3 | March/September | ALH157, IL | VIN140, IN | MCK131, KY | OXF122, OH |
| | | BVL130, IL | KNZ184, KS | MCK231, KY | PRK134, WI |
| | | STK138, IL | CKT136, KY | DCP114, OH | |
| 4 | April/October | ABT147, CT | ANA115, MI | CAT175, NY | EGB181, ON |
| | | SAL133, IN | HOX148, MI | HWF187, NY | LYE145, VT |
| | | ASH135, ME | UVL124, MI | LYK123, OH | |
| | | HOW132,ME | WST109, NH | | |
| 5 | May/November | CON186, CA | QAK172, OH | MKG113, PA | CNT169, WY |
| | | ROM206, CO | KEF112, PA | CDR119, WV | PND165, WY |
| | | GTH161, CO | LRL117, PA | PAR107, WV | |

**Table 3.** Data Quality Indicators for CASTNET Continuous Measurements

| Measurement | | Criteria* | |
|---|---|---|---|
| **Parameter** | **Method** | **Precision** | **Accuracy** |
| Wind Speed | Anemometer | ± 0.5 m/s | The greater of ± 0.5 m/s for winds < 5 m/s or ± 5% for winds ≥ 5 m/s |
| Wind Direction | Wind Vane | ± 5° | ± 5° |
| Sigma Theta | Wind Vane | Undefined | Undefined |
| Relative Humidity | Thin Film Capacitor | ± 10% (of full scale) | ± 5%, rel. hum. > 85% ± 20%, rel. hum. ≤ 85% |
| Solar Radiation | Pyranometer | ± 10% (of reading taken at local noon) | ± 10% |
| Precipitation | Tipping Bucket Rain Gauge | ± 10% (of reading) | ± 0.05 inch† |
| Ambient Temperature | Platinum RTD | ± 1.0°C | ± 0.5°C |
| Delta Temperature | Platinum RTD | ± 0.5°C | ± 0.5°C |
| $O_3$ | UV Absorbance | ± 10% (of reading) | ± 10% |
| Filter Pack Flow | Mass Flow Controller | ± 10% | ± 5% |
| Surface Wetness | Conductivity Bridge | Undefined | Undefined |

**Note:** °C = degrees Celsius
m/s = meters per second
rel. hum. = relative humidity
RTD = resistance-temperature device
UV = ultraviolet

* Precision criteria apply to collocated instruments, and accuracy criteria apply to calibration of instruments
† For target value of 0.50 inch

## Table 4. Data Quality Indicators for CASTNET Laboratory Measurements

| Analyte | Medium | Method | Precision[1] (MARPD) | Accuracy[2] (%) | Nominal Reporting Limits | |
|---|---|---|---|---|---|---|
| | | | | | mg/L | µg/Filter |
| Ammonium ($NH_4^+$) | F | AC | 10 | 90 - 110 | 0.020 * | 0.5 |
| Sodium ($Na^+$) | F | ICP-AES | 5 | 95 - 105 | 0.005 | 0.125 |
| Potassium ($K^+$) | F | ICP-AES | 5 | 95 - 105 | 0.005 | 0.125 |
| Magnesium ($Mg^{2+}$) | F | ICP-AES | 5 | 95 - 105 | 0.003 | 0.075 |
| Calcium ($Ca^{2+}$) | F | ICP-AES | 5 | 95 - 105 | 0.003 | 0.075 |
| Chloride ($Cl^-$) | F | IC | 5 | 95 - 105 | 0.020 | 0.5 |
| Nitrate ($NO_3^-$) | F | IC | 5 | 95 - 105 | 0.008 * | 0.2 |
| Sulfate ($SO_4^{2-}$) | F | IC | 5 | 95 - 105 | 0.040 | 1.0 |

**Note:** [1] This column lists precision goals for both network precision calculated from collocated filter samples and laboratory precision based on replicate samples. The goal for the ICP-AES precision RPD criterion changed from 10 percent to 5 percent at the onset of the new contract beginning on July 30, 2003. The precision criterion is applied as described below:

QC conditions: (v1 = initial response; v2 = replicate response; RL = nominal reporting limit)

Condition 1: if (v1 or v2 < RL and the absolute value of (v1 – v2) < RL) = OK

Condition 2: if (v1-v2) < RL and v1 < 5 x RL) = OK

Condition 3: if (v1 > 5*RL and RPD < 5%) = OK

Status: one of the conditions is OK = Precision QC Passes

[2] This column lists laboratory accuracy goals based on reference standards and continuing calibration verification spikes. The goal for the ICP-AES accuracy criterion changed from 90 – 110 percent to 95 – 105 percent for continuing calibration verification spikes at the onset of the new contract beginning on July 30, 2003. The criterion remains 90 – 110 percent for ICP-AES reference standards.

F = filter pack samples
AC = automated colorimetry
ICP-AES = inductively coupled plasma-atomic emission spectrometry
IC = ion chromatography
MARPD = mean absolute relative percent difference
* = as nitrogen

For more information on analytical methods and associated precision and accuracy criteria, see the CASTNET QAPP, Revision 3.0 (MACTEC, 2005).

## Table 5. QC Analysis Count for Second Quarter 2006

| Filter Type | Parameter | RF Sample Count | CCV Sample Count | RP Sample Count | MB Sample Count | LB Sample Count | FB Sample Count |
|---|---|---|---|---|---|---|---|
| Teflon® | $SO_4^{2-}$ | 35 | 180 | 81 | 17 | 24 | 82 |
| | $NO_3^-$ | 35 | 180 | 81 | 17 | 24 | 82 |
| | $NH_4^+$ | 37 | 176 | 72 | 18 | 24 | 82 |
| | $Cl^-$ | 35 | 180 | 81 | 17 | 24 | 82 |
| | $Ca^{2+}$ | 50 | 192 | 79 | 17 | 24 | 82 |
| | $Mg^{2+}$ | 50 | 192 | 79 | 17 | 24 | 82 |
| | $Na^+$ | 50 | 192 | 79 | 17 | 24 | 82 |
| | $K^+$ | 50 | 192 | 79 | 17 | 24 | 82 |
| Nylon | $SO_4^{2-}$ | 32 | 168 | 76 | 16 | 24 | 82 |
| | $NO_3^-$ | 32 | 168 | 76 | 16 | 24 | 82 |
| Cellulose | $SO_4^{2-}$ | 42 | 163 | 61 | 21 | 22 | 84 |

**Table 6.** Filter Pack Receipt Summary

| | |
|---|---|
| Count of samples received more than 14 days after removal from tower: | 12 |
| Count of all samples received: | 775 |
| Fraction of samples received within 14 days: | 0.984 |
| Average interval in days: | 5 |
| First receipt date: | 04/03/06 |
| Last receipt date: | 06/30/06 |

**Table 7.** Filter Packs Flagged as Suspect or Invalid

| Site ID | Sample ID |
|---|---|
| DCP114, OH | 0619001-27 |
| BEL116, MD | 0614001-09<br>0615001-09 |
| ALH157, IL | 0616001-04<br>0617001-04<br>0618001-04 |
| ROM206, CO | 0618001-69 |
| WSP144, NJ | 0614001-84 |

**Table 8.** Field Problems Affecting Data Collection

| Days to Resolution | Problem Count |
|---|---|
| 30 | 20 |
| 60 | 11 |
| 90 | 0 |
| Unresolved by date of publication | 9 |

**Note:** Counts were extracted using the new problem tracking system (PTS) feature of the CDMSA. Problems requiring corrective action are flagged by field personnel with a ticket number.

**Table 9.** Field Calibration Failures by Parameter

| Site ID | Parameter(s) |
|---|---|
| ANA115, MI | Temperature<br>Relative Humidity<br>Wind Direction |
| ASH135, ME | Wind Direction |
| CAT175, NY | Delta Temperature<br>Wind Direction<br>Precipitation |
| CDR119, WV | Solar Radiation |
| CKT136, KY | Wind Direction |
| CNT169, WY | Wind Direction |
| CON186, CA | Relative Humidity |
| DCP114, OH | Wind Direction |
| GTH161, CO | Wind Direction |
| HOW132, ME | Wind Speed |
| HOX148, MI | Wind Direction |
| LRL117, PA | Relative Humidity |
| LYE145, VT | Temperature<br>Relative Humidity |
| PND165, WY | Relative Humidity |
| ROM206, CO | Wind Direction<br>Precipitation |
| SAL133, IN | Relative Humidity |
| SND152, AL | Wind Direction |
| WSP144, NJ | Wind Direction |

**Note:** Per CASTNET project protocols, data are flagged as "suspect" (S) but still considered valid if the calibration criterion is not exceeded by more that its magnitude (i.e., if within 2x the criterion). If ozone or flow calibrations fall within 2x the criteria, these data are adjusted per approved protocol described in the CASTNET QAPP, Revision 3.0 (MACTEC, 2005).

**Figure 1.** Reference Standard Results for Second Quarter 2006 (percent recovery)

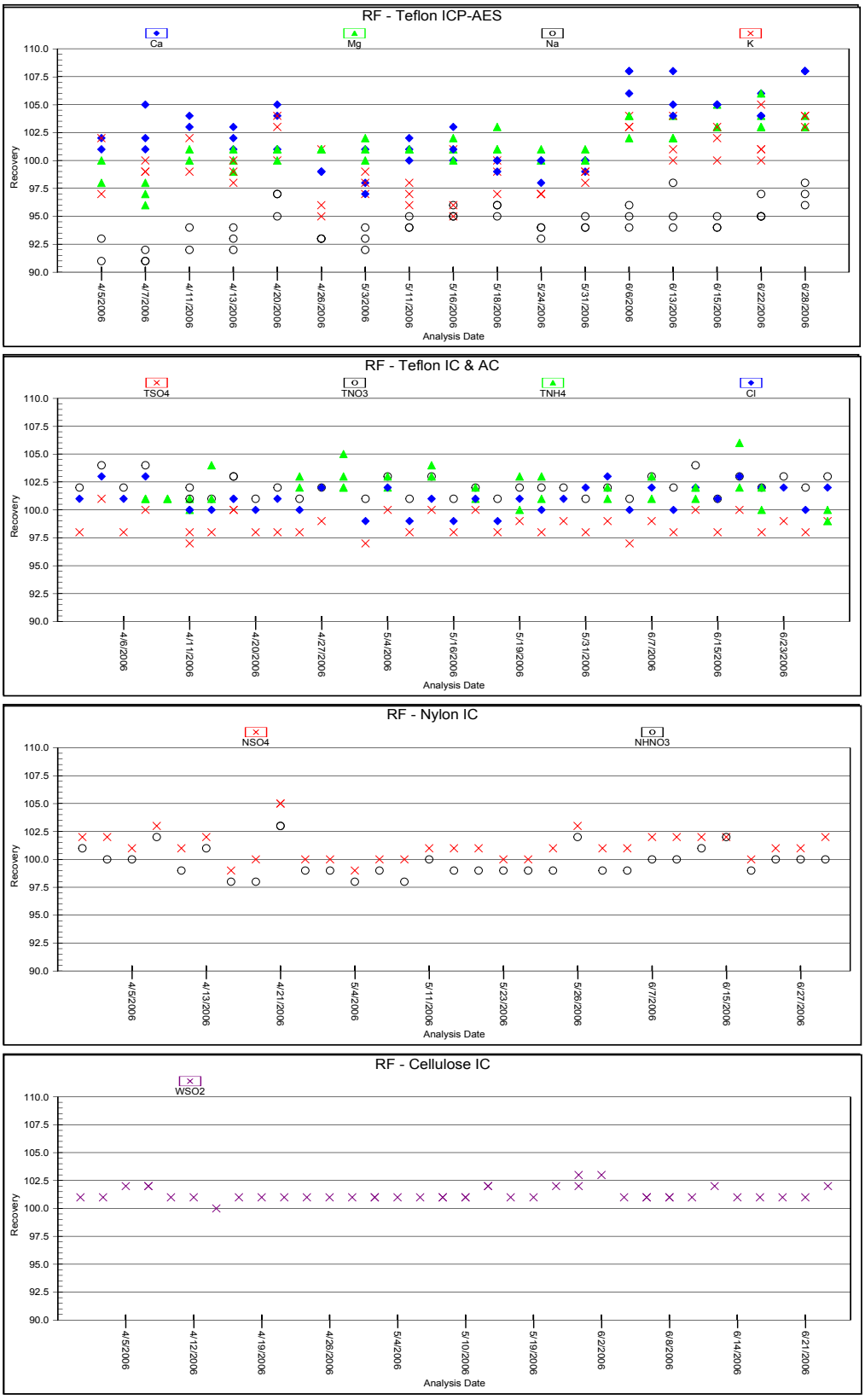


**Figure 2.** Continuing Calibration Verification Spike Results for Second Quarter 2006 (percent recovery)

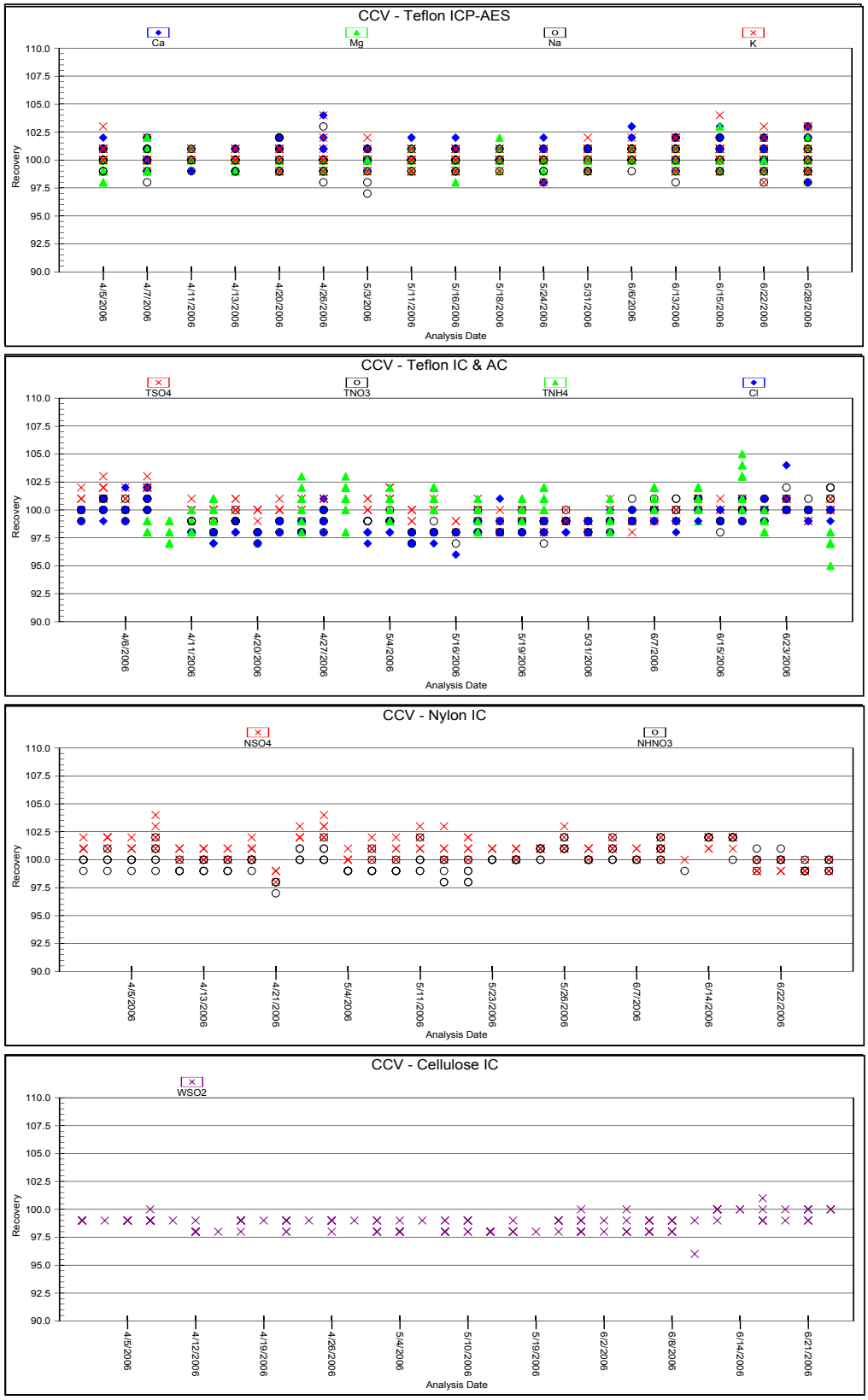
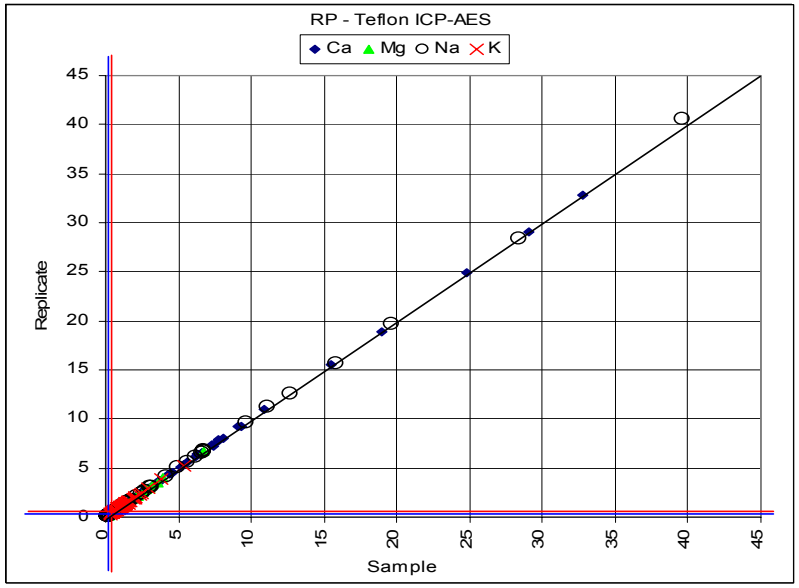
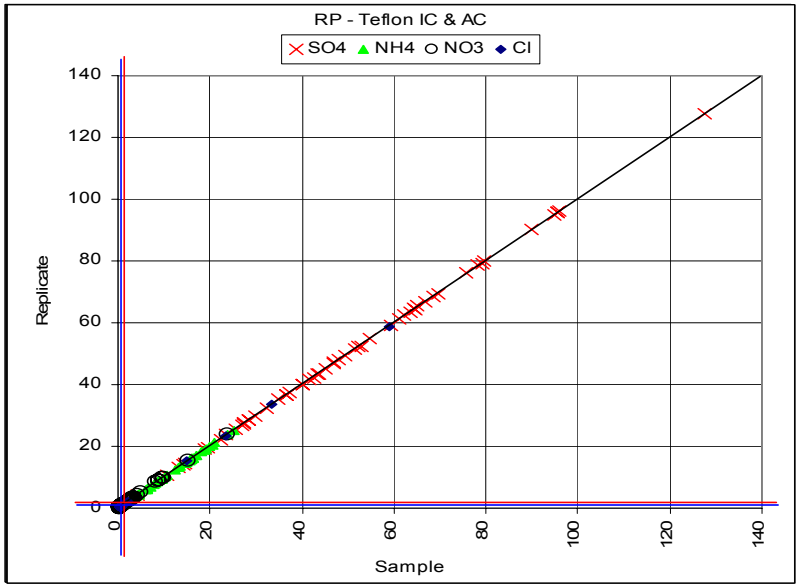
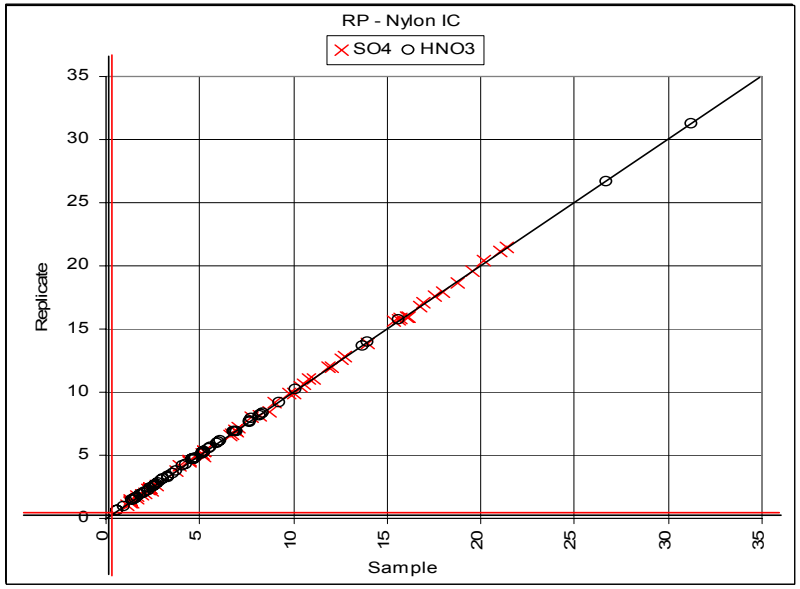


**Figure 3.** Replicate Sample Analysis Results for Second Quarter 2006 (total micrograms)



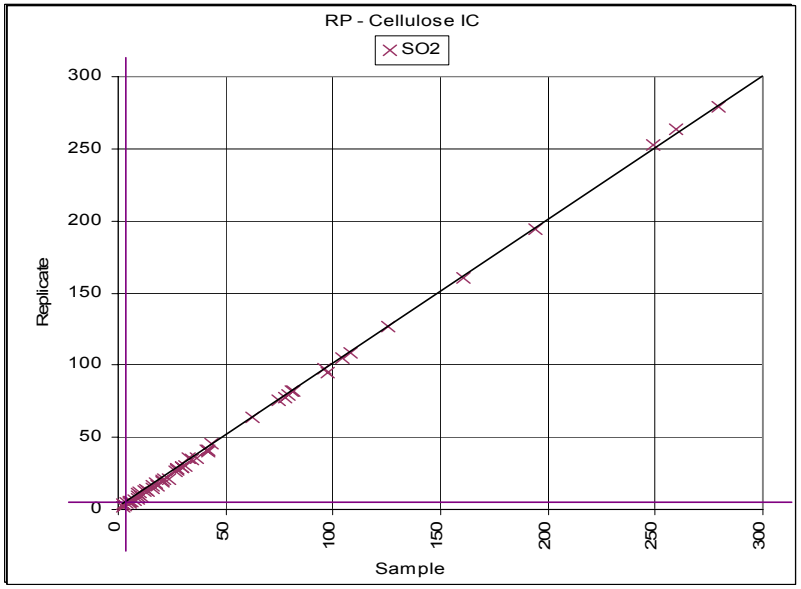
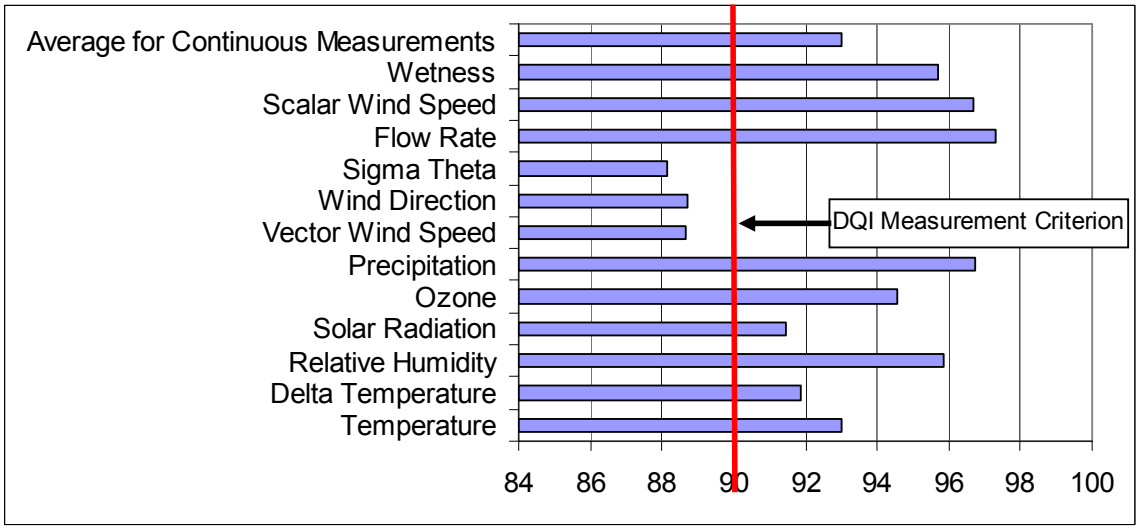



**Figure 4.** Percent Completeness of Measurements for Fourth Quarter 2005 through First Quarter 2006*




Note: *Presents Level 3 data available during the second quarter of 2006.

**Figure 5.** Method Blank Analysis Results for Second Quarter 2006 (total micrograms)

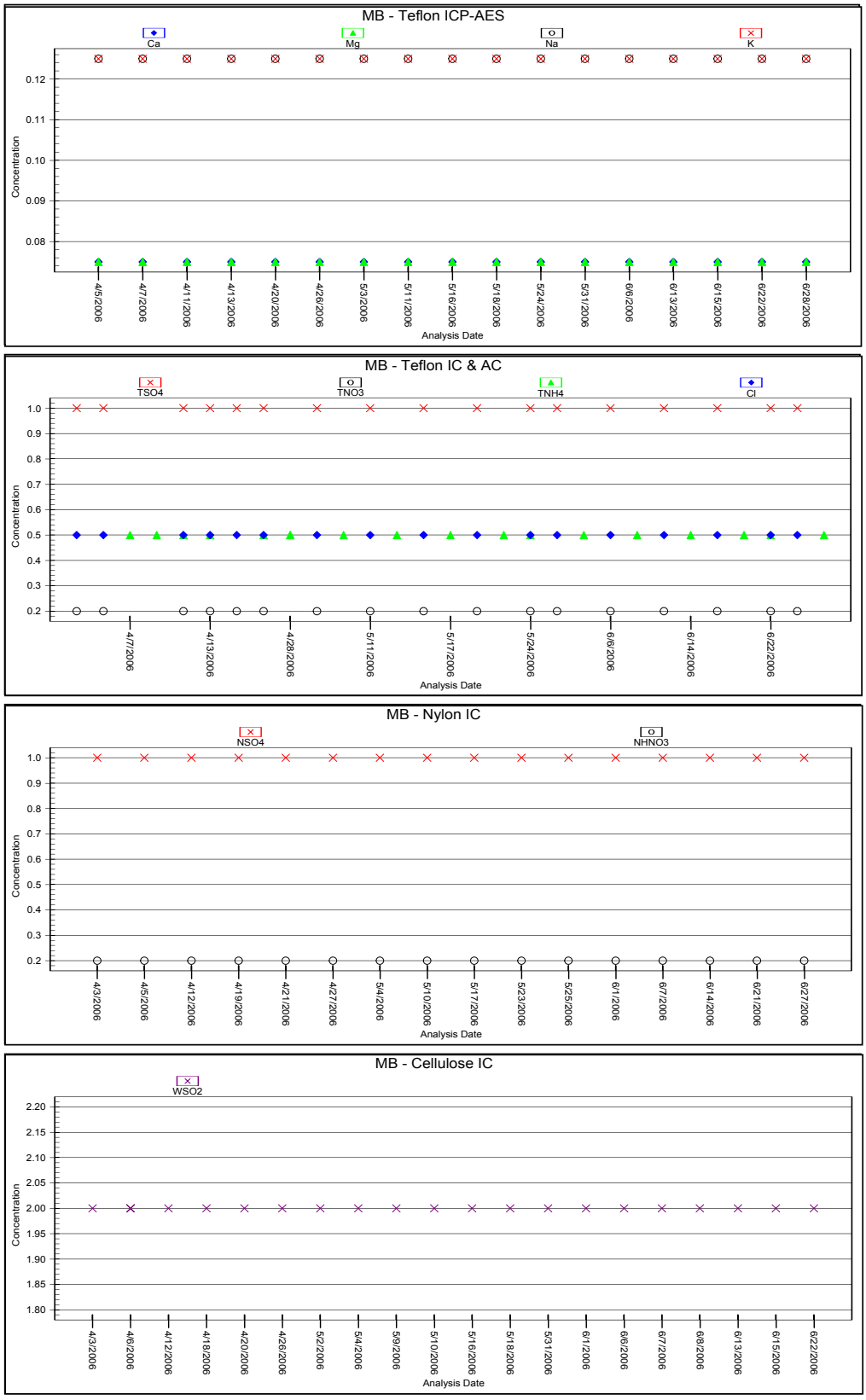


**Figure 6.** Laboratory Blank Analysis Results for Second Quarter 2006 (total micrograms)

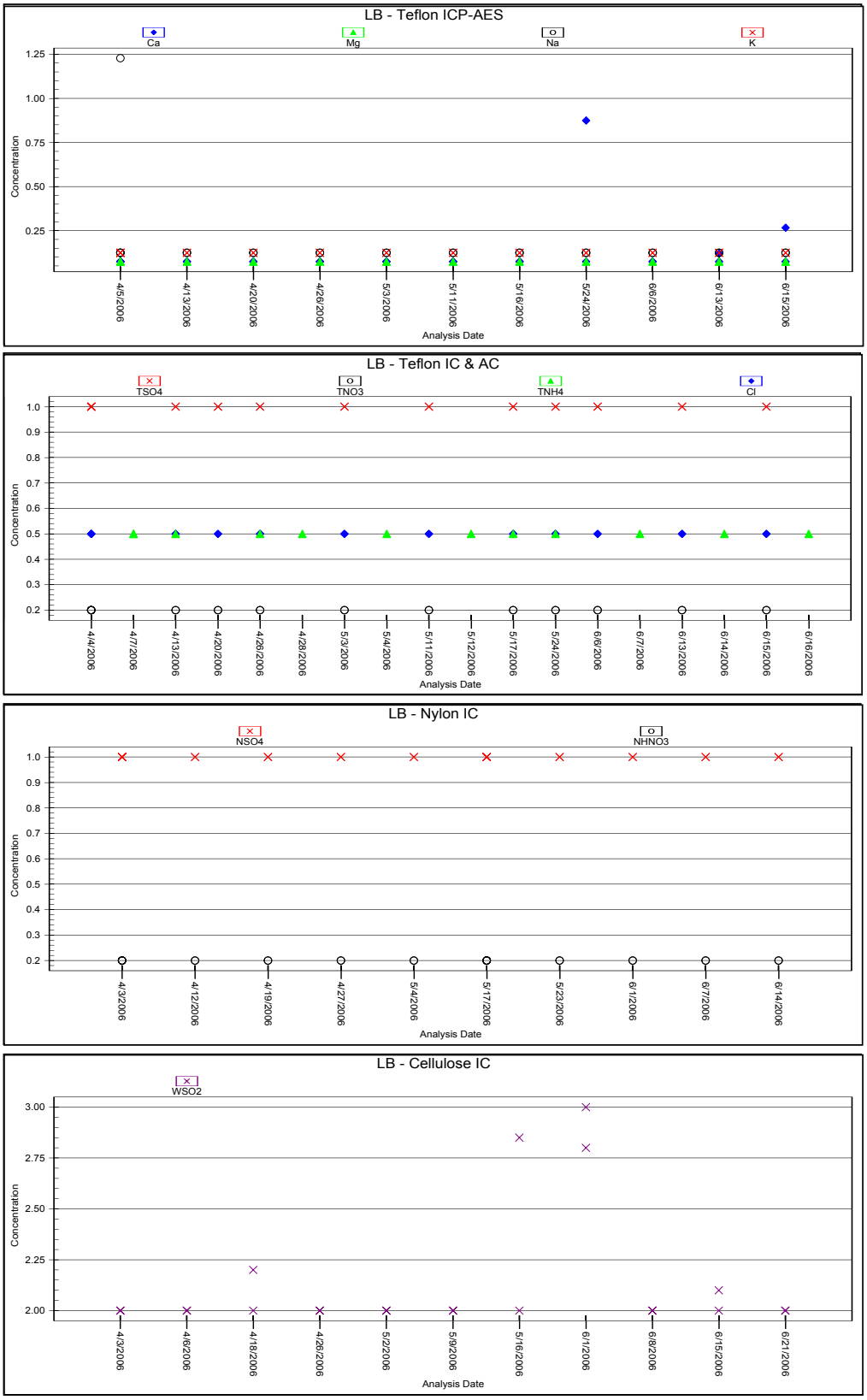


**Figure 7.** Field Blank Analysis Results for Second Quarter 2006 (total micrograms)